

WHAT IS CLAIMED IS:

1. A system for detecting a target nucleic acid sequence comprising:
 - a support comprising an electrode and a nucleic acid probe attached thereto, wherein the nucleic acid probe comprises a sequence complementary to the target nucleic acid sequence;
 - a non-covalent photoelectrochemical label for contacting with the nucleic acid probe;
 - a light source for irradiating the nucleic acid probe; and
 - a data collection controller for measuring a current at the electrode.
2. The system of claim 1, wherein the nucleic acid probe comprises DNA.
3. The system of claim 1, wherein the nucleic acid probe comprises RNA.
4. The system of claim 1, wherein the target nucleic acid sequence comprises a DNA sequence.
5. The system of claim 1, wherein the target nucleic acid sequence comprises an RNA sequence.
6. The system of claim 1, wherein the support comprises an array of nucleic acid probe elements.
7. The system of claim 6, wherein the array comprises greater than about 10 nucleic acid probe elements.
8. The system of claim 1, wherein the electrode comprises at least one of gold, platinum, silicon, glassy carbon, graphite, indium-tin oxide, and diamond.
9. The system of claim 1, wherein the non-covalent photoelectrochemical label is a compound comprising:
 - a metal comprising at least one of ruthenium, osmium, cobalt, rhodium, nickel, and platinum; and
 - a ligand comprising at least one of polypyridyl ligands, 2,2'-bipyridine, 1,10-phenanthroline, 4,7-diphenyl-1,10-phenanthroline, dipyrdo[3,2-*a*:2',3'-*c*]phenazine, 9,10-phenanthrenequinone diimine, 2,2':6',2''-terpyridine, and derivatives thereof.

10. The system of claim 9, wherein the non-covalent photoelectrochemical label comprises a cation is selected from the group consisting of $[\text{Ru}(\text{bipy})_3]^{2+}$, $[\text{Ru}(\text{bipy})_2\text{dppz}]^{2+}$, $[\text{Ru}(\text{phen})_3]^{2+}$, and combinations thereof.

11. The system of claim 1, wherein the light source is a laser.

12. The system of claim 1, wherein the light source radiates visible light.

13. The system of claim 1, further comprising a sacrificial reductant for contacting with the nucleic acid probe.

14. The system of claim 1, wherein the sacrificial reductant comprises at least one of a tertiary amine, tripropylamine, ethylenediaminetetraacetic acid, and salts thereof.

15. The system of claim 1, further comprising an optical scanner for scanning the support.

16. The system of claim 1, further comprising a fluid handling system for the support.

17. The system of claim 1, further comprising a temperature control system for the support.

18. The system of claim 1, wherein the support further comprises machine readable identifying indicia.

19. A method for detecting a target nucleic acid sequence comprising:

contacting a nucleic acid probe with a target nucleic acid and a non-covalent photoelectrochemical label to form a reaction mixture, wherein

the nucleic acid probe is attached to an electrode,

the nucleic acid probe comprises a sequence complementary to the target nucleic acid sequence, and

a support comprises the nucleic acid probe and the electrode;
irradiating the mixture; and

observing a photocurrent at the electrode, wherein the photocurrent indicates the presence and/or amount of the target nucleic acid.

20. The method of claim 18, wherein the nucleic acid probe comprises DNA.

21. The method of claim 18, wherein the nucleic acid probe comprises RNA.

22. The method of claim 18, wherein the target nucleic acid comprises DNA.

23. The method of claim 18, wherein the target nucleic acid comprises RNA.
24. The method of claim 18, wherein the support comprises an array of nucleic acid probe elements.
25. The method of claim 18, wherein the array comprises greater than about 10 nucleic acid probe elements.
26. The method of claim 18, wherein the electrode comprises at least one of gold, platinum, silicon, glassy carbon, graphite, indium-tin oxide, and diamond.
27. The method of claim 18, wherein the non-covalent photoelectrochemical label is a compound comprising:
 - a metal comprising at least one of ruthenium, osmium, cobalt, rhodium, nickel, and platinum; and
 - a ligand comprising at least one of polypyridyl ligands, 2,2'-bipyridine, 1,10-phenanthroline, 4,7-diphenyl-1,10-phenanthroline, dipyrdo[3,2-*a*:2',3'-*c*]phenazine, 9,10-phenanthrenequinone diimine, 2,2':6',2''-terpyridine, and derivatives thereof.
28. The method of claim 27, wherein the non-covalent photoelectrochemical label comprises a cation is selected from the group consisting of $[\text{Ru}(\text{bipy})_3]^{2+}$, $[\text{Ru}(\text{bipy})_2\text{dppz}]^{2+}$, $[\text{Ru}(\text{phen})_3]^{2+}$, and combinations thereof.
29. The method of claim 18, wherein the nucleic acid probe is irradiated using a laser.
30. The method of claim 18, wherein the nucleic acid probe is irradiated with visible light.
31. The method of claim 18, further comprising contacting the nucleic acid probe with a sacrificial reductant or sacrificial oxidant.
32. The method of claim 30, wherein the sacrificial reductant comprises at least one of a tertiary amine, tripropylamine, ethylenediaminetetraacetic acid, and salts thereof.
33. The method of claim 30, further comprising maintaining the nucleic acid probe under conditions conducive for nucleic acid hybridization.
34. The method of claim 30, further comprising washing the nucleic acid probe to remove excess nucleic acid target.

35. The method of claim 30, further comprising washing the nucleic acid probe to remove excess non-covalent photoelectrochemical label.

36. A kit for detecting a target nucleic acid sequence comprising:

a support comprising an electrode and a nucleic acid probe attached thereto, wherein the nucleic acid probe comprises a sequence complementary to the target nucleic acid sequence; and

a non-covalent photoelectrochemical label.

37. The kit of claim 36, wherein the nucleic acid probe comprises DNA.

38. The kit of claim 36, wherein the nucleic acid probe comprises RNA.

39. The kit of claim 36, wherein the support comprises an array of nucleic acid probe elements.

40. The kit of claim 36, wherein the electrode comprises at least one of gold, platinum, silicon, glassy carbon, graphite, indium-tin oxide, and diamond.

41. The kit of claim 36, wherein the non-covalent photoelectrochemical label is a compound comprising:

a metal comprising at least one of ruthenium, osmium, cobalt, rhodium, nickel, and platinum; and

a ligand comprising at least one of polypyridyl ligands, 2,2'-bipyridine, 1,10-phenanthroline, 4,7-diphenyl-1,10-phenanthroline, dipyrdo[3,2-*a*:2',3'-*c*]phenazine, 9,10-phenanthrenequinone diimine, 2,2':6',2"-terpyridine, and derivatives thereof.

42. The kit of claim 41, wherein the non-covalent photoelectrochemical label comprises a cation is selected from the group consisting of $[\text{Ru}(\text{bipy})_3]^{2+}$, $[\text{Ru}(\text{bipy})_2\text{dppz}]^{2+}$, $[\text{Ru}(\text{phén})_3]^{2+}$, and combinations thereof.

43. The kit of claim 36, further comprising a sacrificial reductant or sacrificial oxidant.

44. The kit of claim 43, wherein the sacrificial reductant comprises at least one of a tertiary amine, tripropylamine, ethylenediaminetetraacetic acid, and salts thereof.

45. The kit of claim 36, wherein the support further comprises machine readable identifying indicia.